Ontario

Ministry of
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NO 52

MATERIALS INFORMATION

ENGINEERING MATERIALS OFFICE

ACCELERATED METHODS

OF

PERFORMANCE TESTING OF TRAFFIC PAINT

by

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SUMMARY

An accelerated abrasion testing of traffic paint test samples under high density traffic conditions was carried out during the summer and fall of 1982 to enable paint selection for purchase in 1983. Eleven samples each of white and yellow paints were received for testing from seven manufacturers. After laboratory physical and chemical analyses of the paints, ten samples including a previously field tested paint sample (Ibis Niteline) were field service tested for four months beginning in 82 08 16. Based on the service test results, three paint manufacturers' products with abrasion resistance characteristics similar to that of Niteline paint were selected and approved for purchase in 1983.

The service test results showed that the accelerated abrasion testing and the short testing period did not provide a very satisfactory method of separating the durable paints from those with lesser durability because the test period did not include exposure of the stripes to winter maintenance conditions. It appeared that one full year of service testing including severe winter conditions to which the test stripes were subjected in previous evaluations should still be considered a mandatory requirement for satisfactory evaluation of traffic paints for durability. The "merry-go-round" method of accelerated performance testing of traffic paint was also tried experimentally but it was found to be unsatisfactory because of irregular wear characteristics of the test stripes due to the unevenness and roughness of the pavement surface at the wheel tracks.

INTRODUCTION

The qualification testing of traffic paints has been performed by the Chemicals Section for more than twenty-five years. During the early 1950's, paint samples were being tested annually from June to December in order to select paints for purchase in January of the following year. This six-month field service test resulted in the selection of traffic paints which lasted approximately six-months but failed to remain on the pavement through the winter months. In the late 1950's the test period was extended to one full year from June of one year to June of the following year in order to ensure that traffic zone marking paints lasted at least one year in most areas except possibly in high density traffic areas. The latter test procedure improved the quality and durability of the traffic paints purchased by the Ministry. The selection of traffic paints based on the one-year field performance test could not be completed in time for the annual tendering process because the latter was carried out generally in January or February of each year during the middle of the paint evaluation period. The evaluation of traffic paint was therefore a two-year test cycle.

Recently, there were complaints from other offices within the Ministry, namely, the Equipment Office, that the two-year test cycle was too long. Modification of the field performance test procedure whereby the paint samples could be evaluated rapidly within a few months for purchase in the following year (shades of the 1950's!) was proposed at numerous meetings held in 1980-82 with Equipment, Maintenance Services, Purchasing, and Engineering Materials Offices.

The following decisions were made:

- modify the paint specifications and test applicator to accomodate the various changes in paint characteristics requested by the Equipment and the Standards Offices.

- request paint samples, based on the revised specification, from suppliers for evaluation in 1982 and possible purchase in 1983.

- accelerate the field testing by applying the test paints in a high traffic area (the paints were applied on the westbound express lanes of Highway #401 just West of the Keele Street overpass).

- investigate if (accelerated) service testing using the "merry-go-round" (located north of parking lot "J") could be satisfactorily utilized as a possible substitute for field service testing on a highway .

REVISED SPECIFICATION

Prior to 1982, there were two M.T.C. traffic paint specifications:

(1) Form 1710 Material Specification for Coning (Regular Dry) Traffic Paint.

(2) Form 1711 Material Specification for Non-Coning Hot Spray Traffic Paint.

In February 1982, the two traffic paint specifications were revised and incorporated into a single standard manual format, M.T.C. 1710 Material Specification for Coning and Non-Coning Traffic Paint (APPENDIX 1). This revised specification included the required modifications such as additional specific paint requirements for pigment content, vehicle solids type and content as well as requirements for loading, application, paint production, and quality assurance. The above mentioned specific paint requirements were added at the request of the Equipment Office and were meant to represent the characteristics of this Niteline traffic paint which the Equipment Office claimed to be the paint best compatible with the Ministry's application equipment.

TEST STRIPE APPLICATOR

Prior to 1960, test stripes for field performance testing of coning type traffic paint were applied by means of a hand operated applicator consisting of a self-propelled, pressure-fed type spray unit.

Paint thickness control was a very difficult "hit and miss" affair dependent on applicator speed and paint pressure. This applicator was later replaced by a displacement type of striper in which paint delivery was controlled through a piston geared to the drive wheel of the unit. The application speed of these units was about 1 m/s. In the mid 1970's the cold and hot airless spray method of traffic paint application was introduced. In order to simulate heated airless spray application, an electrically operated traffic paint test striper was constructed to apply test stripes for the field service testing of traffic paints by airless spray method. The construction and operation of this equipment was described in the Engineering Materials Office - Materials Information Report No. 32*.

Because of the increased speed of zone striping (up to 15 km/h) and the need to duplicate the equipment required for this type of paint application, the test stripe applicator was again modified in 1982 to operate at the higher speed of about 3 m/s using an air motor drive and two tandem spray guns with 435 tips. At this velocity, at least three lanes of pavement were required in order to apply 3-meter test stripes at 255 µm dry film thickness transversely across the middle lane of a 3-lane highway.

The test applicator modified as indicated above was used for the 1982 traffic paint evaluation.

TEST MATERIALS

Invitations to submit traffic paint test samples meeting the revised specifications (M.T.C. Form 1710 Material Specification for Coning and Non-coning Traffic Paints, February 1982) were sent by the Purchasing Office to approximately ninety paint suppliers. Eleven samples each of white and yellow traffic paint were received from seven suppliers for the 1982 evaluation and are listed in APPENDIX 3.

For comparison of durability, Ibis Niteline white traffic paint, Code No. 40-3234, Batch 60D82, obtained from Toronto District, was included in the field performance tests.

* Operating Manual for Traffic Paint Test Striper, June 1982 by W. J. Komarnicki and A. Kagetsu

In addition to the non-coning test paints one supplier, Ibis Products Ltd., requested and obtained approval to apply (utilizing his own equipment and labour) an epoxy marking material, "Super Lifeline III", adjacent to the M.T.C. applied test stripes.

Two test stripes of this material was applied at 375 - 500 µm and at 750 µm dry film thickness with reflectorizing glass beads applied at the rate of 3 kg/L (30 lbs./gal.). The application temperature of the material was reported to be 44°C.

TEST SITES

For the field service tests, the paint samples were applied on Highway #401, westbound express, centre lane at Site #12. The area suggested by the Maintenance Services Office was Site #13 but the open carpet texture of the pavement surface in this area was found to be unsuitable for paint test stripe application. Therefore, the paints were applied at Site #12 where the pavement texture was much smoother. The average daily traffic at this site was 16,500 over the centre lane during the period August 16 to August 30, 1982.

In addition, the white traffic paint samples were applied at the "merry-go-round" test site (APPENDIX 5) in order to determine whether this accelerated test method could be used for traffic paint durability determinations. The "merry-go-round" rig consisted of four 205 x 14 all-season radial automobile tires mounted on wheels attached to arms perpendicular to each other and running on three concentric tracks from 5.5 to 6.0 metres in diameter. The unit was belt driven by an electric motor mounted on each of the two centre track drive wheels. The total mass of each of the drive wheels was 305 kg and that of each of the other two wheels was 145 kg. The unit made six rotations per minute over HL 3 bituminous pavement.

TEST PROCEDURE (APPENDIX 4)

It was the intent of the laboratory to test all of the traffic paint samples for physical and chemical requirements and to apply on the

highway only those white traffic paint samples which met laboratory test requirements. The yellow traffic paint samples were considered to have similar characteristics as the corresponding white paint sample except for pigmentation so that they were not field service tested.

Nine test samples of white traffic paint plus Nitelline paint were applied on the highway during the evening of August 16 and 17, 1982 using the newly modified traffic paint test striper. Because of the small number of paints meeting laboratory test requirements (5 samples) four test samples which failed to meet laboratory test requirements were also field service tested to obtain additional comparative test data only. Two white paint samples were not service tested (International and Korzite) because these paints deviated excessively from specification requirements. The paint application temperature at the spray gun was maintained at 50°C with an application pressure of 5512 kPa (800 psi). The ambient temperature on each night was about 15°C. It was cloudy, with a slight easterly wind.

During application of the test stripes, paint characteristics such as sprayability, paint spatter, overspray, and glass bead embedment properties were noted. The speed of the striper was adjusted to apply stripes of 225 µm dry film thickness for each of the paint samples. Reflectorizing glass beads were applied on the test stripes at the rate of 0.7 kg/L at 207 kPa (30 psi) pressure. The specification for glass beads was M.T.C. Form 1750, was revised in February 1982 (APPENDIX 2).

After four months of exposure to traffic, the test stripes were evaluated for wear, reflectance, and general appearance. Wear of the paint stripes was determined by taking close-up photographs of the stripes and estimating the percentage of paint remaining in the area of greatest traffic wear. Reflectance was measured by means of the M.T.C. reflectometer and general appearance of the test stripes was rated on a scale of 0 to 10 where 0 was complete failure and 10 was perfect.

TEST RESULTS

Laboratory Physical and Chemical Tests (Tables 1 and 2)

The physical and chemical characteristics of the paint samples

were tested in the laboratory to determine whether they conformed to the requirements of Table 1 of the M.T.C. Form 1710 specification for non-coning traffic paint except for the settling requirement. This test requires a 12 months testing period. Of the eleven samples each of white and yellow traffic paint, only two white (XYZ PC 80WX13 and Sherwin Williams PE 3908) and two yellow (XYZ 7YX144 XYZ PC 80YX144) paints completely met the physical and chemical requirements of the specification except for the settling. All of the others failed in one or more of the specification requirements. Although the phthalic anhydride content requirement of the specification was based on that of the Niteline traffic paint, laboratory tests indicated that the 1982 Niteline paint used for comparison did not meet the 40% minimum requirement. It was found to contain 38.7% phthalic anhydride. Therefore a 1.5% variation from the phthalic anhydride content requirement was allowed in all paint samples. This permitted an additional three white paints (Niagara 103588 and 103590 and XYZ 7WX13) and two yellow paints (Niagara 103589 and 103591) to be considered for field service tests.

Although it was not specified the paint samples were filtered through a #60 mesh (250 µm opening) sieve in order to determine the type and size of any foreign particles in the paint samples. It was found that most samples contained particles of dried paint of about 250 to 500 µm diameter and fibrous material and glass or quartz chips of about 125 to 250 µm in diameter. The silica or glass chips which were detected in the XYZ and Ibis paint samples may cause wearing of airless spray gun tips due to the hardness and angular shape of the glass or quartz chips.

According to the manufacturers' paint data, the total solids by volume of most of the samples ranged from 51 to 55%. Three manufacturers' samples (International, Korzite, and Sherwin Williams) had total solids contents of only 44 to 46% by volume. This meant that about 20% more paint was required of these three paints in order to obtain equivalent dry film thickness as the Niteline and the other paint samples. For example, if 400 µm wet film thickness of Niteline paint were required to yield a stripe of 225 µm dry film thickness, then 480 µm wet film thickness of Sherwin Williams paint would be required in order to apply a stripe of equal dry film thickness.

"Super Lifeline III" epoxy coating was a special striping material which was applied by the supplier, Ibis Products Ltd. This proprietary product did not conform to the M.T.C. traffic paint specification and no test sample of the material was received or tested by the laboratory at the time of the evaluation.

Field Service Tests (Table 3)

Of the 10 samples of white traffic paints, including Niteline paint, applied on the highway test site, only one sample (Niagara Paint 103590) was considered to have excessive overspray; all the others were rated as having slight to fair and acceptable overspray. This "rating" was arrived at by staff of the Chemicals and Maintenance Services Offices by examining samples of test stripes taken on 51 cm x 71 cm black sheets of cardboard. The 1982 Niteline white paint used for comparison showed the least paint overspray.

The no pick-up time of all of the beaded test stripes varied from one to two minutes under the following test conditions prevailing at the time of paint application:

Air temperature	15°C
Pavement temperature	14°C
Paint temperature at gun	50°C
Cloudy, cool, slight easterly wind	

It was not possible to determine the no tracking time on the short transverse test stripes at the highway test site. It was our opinion that this paint requirement was best determined by applying the paints on the highway with the regular zone striping machine and which required a greater amount of paint sample was available at the time of the evaluation.

"Merry-go-round" Test

The new pavement surface was prepared prior to the application of the test stripes by running the wheels of the rig over the pavement surface for about two weeks to remove the fines and to expose the larger aggregate in the pavement. Test stripes of seven white traffic paint samples including Niteline paint were applied on 82 11 18 under clear, cool weather at about 8°C air temperature. The stripes were applied at an angle of about 45° to the tangent using the modified test stripe applicator. After approximately 64,000 revolutions of the rig (about

two weeks of continuous rotation) all of the test stripes appeared to show the same degree of wear and it was not possible to separate the better wearing paints from those with poor durability. An additional 64,000 revolutions of the rig did not show increased wearing of the stripes. The tires were apparently riding on the high spots or exposed aggregate in the pavement.

CONCLUSIONS

Based on the relative durabilities determined by four months of accelerated service testing of traffic paint samples on a high traffic density highway, the following three paint samples appeared to have comparable abrasion resistance properties and they may be considered for purchase by the Ministry in 1983:

Manufacturer	White Paint	Yellow Paint
Ibis Products Ltd. (1)	40-3234 (Niteline)	40-3235 (Niteline)
Niagara Paint & Chemical Co. Limited	103588	103589
Sherwin Williams Canada Inc. (2)	PE 3908	PE 3909

Note (1) The Ibis white Niteline sample used as a durability control paint in this test program was approved in a previous field experimental evaluation of traffic paints. Although Ibis Niteline paint was not re-submitted by the manufacturer for the current evaluation, it has been included in the list of approved paints on the basis of good durability rating determined in previous and current evaluations.

Note (2) For the service test all paints were applied at equal dry film thickness of 225 µm. The Sherwin Williams products were found to contain about 20% less solids by volume than either Niteline or the Niagara Paint products. This meant that a greater volume of Sherwin Williams traffic paints was required in order to yield equivalent dry film thickness as the other paints. The bid price of Sherwin Williams products should therefore be adjusted by dividing it by 80% in order to base the price on equal solids content for all paints.

The Sherwin Williams yellow paint sample had more than the specified maximum water content possibly caused by laboratory formulating conditions.

All other paint samples tested failed to meet laboratory and accelerated durability test requirements and were not approved (Tables 4 and 5).

The "merry-go-round" method of accelerated performance testing of traffic paints was not satisfactory under the conditions of the experiment because of irregular wearing of the test stripes due to unevenness and roughness of the pavement surface at the wheel tracks.

The abridged method of abrasion testing of traffic paints under high density traffic conditions as used in this evaluation, does not significantly differentiate the durabilities of the test paints. Cold winter temperatures, sand, and de-icing chemicals, etc. appear necessary for paint film durability determinations that are based on chipping, flaking, as well as on abrasion. Because of purchasing requirements the current list of approved paints had to be compiled before the test paints were subjected to these severe winter conditions. It is recommended, therefore that the previous method of traffic paint evaluation requiring one full year of exposure including winter maintenance conditions, that is the two-year evaluation cycle, be reinstated.

To control the coarse and foreign particles in the paint that could cause accelerated wear of spray equipment, it is recommended that an additional requirement be included in the traffic paint specification limiting the coarse particles in the size range 60 to 100 mesh. It is recommended that the paint shall completely pass #60 sieve and allow a maximum of 0.01% by mass retained on #100 sieve. In addition, a maximum in solvent content by volume shall be specified in order that all of the paints have equivalent solids contents. A maximum of 46% by volume of volatile matter is recommended based on the Nitoline type paint composition.

Table 1

Laboratory Physical and Chemical Test Results-White Paints

Lab. No. 82-S-	Mfr.	Code No.	Mass kg/L	Viscosity 25°C	Viscosity 7°C	NPU mins.	Settle 12 months	Water %	Bleed	Fineness	Pig. %	Veh. Solids %	TiO_2 k/L	Phth. Anhyd. %	Hide m^2/L	Reflect. Y
50003	International	C-3424	1.42	80.5	103.6	16	not available at time of report	0.75*	4.5*	5.5	51.2	21.2	0.194	33.8*	11.9	83.8
50005	Korzite	O-5566	1.31	89.2	>143 *	9		0.20	5.0	5.0	45.4	19.9	0.154	43.6	11.9	87.6
50006	Niagara	103588	1.57	80.6	106.9	15		0.20	6.0	5.5	54.0	18.6	0.166	39.6*	8.6	86.2
50007	Niagara	103590	1.49	80.0	96.5	17		0.45	6.0	4.0	53.9	18.6	0.166	39.5*	9.2	84.0
50010	XYZ Paint	7WX13	1.58	83.7	101.7	8		0.20	6.0	4.5	49.9	18.0	0.151	39.8*	8.9	85.2
50011	XYZ Paint	7WX14	1.59	79.8*	91.6	10		0.10	6.0	4.5	49.0	17.3*	0.159	41.3	9.5	86.4
50014	XYZ P.C. Ltd.	PC80WX13	1.58	83.4	103.1	7		0.04	5.5	5.5	49.7	18.2	0.150	40.8	9.5	85.2
50015	XYZ P.C. Ltd.	PC80WX15	1.59	81.0	91.1	9		0.50	5.5	5.5	48.8	17.3*	0.184	41.1	10.2	86.8
50020	Sherwin Williams	PE 3908	1.39	81.0	114.8	13		0.50	6.0	3.5	49.4	20.0	0.169	40.7	9.5	88.8
50022	Ibis	40-3417	1.57	88.9	103.1	13		0.45	6.0	3.0	55.3*	18.6	0.158	38.3	9.8	81.4*
50023	Ibis	40-3419	1.57	90.3*	104.1	15		0.40	6.0	3.0	55.8*	18.4	0.160	40.0	9.8	81.5*
Specs.			-	80-90	120 max.	-	8 min.	0.5 max.	5 min.	3 min.	54.0 max.	18.0 min.	0.15 min.	40 min.	8.37 min.	84 min.

* Indicates failure to meet specification requirements

Table 2

Laboratory Physical and Chemical Test Results-Yellow Paints

Lab. No. 82-S-	Mfr.	Code No.	Mass kg/L	Viscosity 25°C	Viscosity 7°C	NPU mins.	Settle 12 months	Water %	Bleed	Fineness	Pig. %	Veh. Solids %	TiO_2+ $PbCrO_4$ kg/L	Phth. Anhyd. %	Hide m^2/L	Reflect. Y
50004	Korzite	0-5572	1.36	90.5*	>139.0*	10	not available at time of report	0.3	4.5*	5.0	49.4	18.3	0.174	44.4	12.4	61.6
50008	Niagara	103589	1.60	82.8	106.5	13		0.3	6.5	5.0	53.1	18.8	0.163	39.1*	8.4	63.3
50009	Niagara	103591	1.49	80.2	99.9	15		0.3	6.5	5.0	53.7	18.6	0.165	39.1*	8.9	63.0
50012	XYZ Paint	7YX13	1.59	90.4*	113.8	7		0.5	6.5	5.5	50.2	17.1*	0.148*	40.0	9.2	65.5
50013	XYZ Paint	7YX14	1.61	89.6	112.2	11		0.3	6.5	5.0	49.0	18.9	0.210	43.2	10.2	63.5
50016	XYZ P.C. Ltd.	PC80YX13	1.59	90.0	112.8	7		0.5	6.0	5.5	50.1	17.1*	0.149*	41.8	8.6	65.9
50017	XYZ P.C. Ltd.	PC80YX14	1.62	89.4	112.5	11		0.4	6.0	4.0	48.9	19.2	0.211	41.3	9.8	63.5
50021	Sherwin Williams	PE 3909	1.38	83.0	105.9	12		1.2*	7.0	3.5	48.2	19.8	0.167	40.9	9.2	62.9
50024	Ibis	40-3418	1.58	83.8	94.0	11		0.5	6.5	3.0	55.3*	17.3*	0.159	38.4*	9.5	61.5
50025	Ibis	40-3420	1.58	81.9	88.3	12		1.8+*	6.0	3.5	54.0	17.5*	0.155	39.1*	9.5	60.8
50026	International	C-3423	1.36	79.3*	113.1	15		0.5	6.0	5.0	50.7	20.5	0.183	35.4*	9.5	57.8*
Specs.			-	80-90	120 max.	-	8 min.	0.5 max.	5 min.	3 min.	54 max.	18 min.	0.15 min.	40 min.	8.37 min.	60 min.

* Indicates failure to meet specification requirements

Table 3

Field Service Test Results - Hwy. 401 at Keele St., Westbound Express

Line No.	Paint	% Paint Remaining	% Beads Remaining	Reflectance after 4 months	Appearance after 4 months	Overspray	% Solids by Volume- mfr. data
5	Ibis 40-3234 Niteline for control	98.0	15 - 20	23.8	8.0 - 8.5	very slight	56
9	Niagara 103588	98.5	30 - 40	25.4	8.0	slight	55.25
11	XYZ 7WX13	97.3	3	24.4	8.0	slight	53.3 ± 1
13	XYZ PC80WX13	96.0	3 - 5	24.6	7.5 - 8.0	slight-fair	53.3 ± 1
15	Niagara 103590	97.3	5	25.3	7.5 - 8.0	Excessive	51.25
20	Sherwin Wm. PE 3908	98.0	10	25.6	7.5 - 8.0	slight-fair	45.9
26	XYZ 7WX14	92.3	3	22.6	6.5 - 7.0	slight-fair	53.4 ± 1
29	XYZ PC80WX15	89.5	1 - 3	23.1	6.5 - 7.0	slight-fair	53.4 ± 1
32	Ibis 40-3417	96.5	1 - 3	22.8	6.5 - 7.0	slight-fair	51.2
34	Ibis 40-3419	95.5	1	22.4	6.0 - 6.5	slight-fair	51.1
	Ibis Epoxy 375 - 500 µm	99.5	90 - 95	28.0	10	-	100
	Ibis Epoxy 750 µm	99.8	80 - 90	26.8	10	-	100
	Pavement Surface	-	-	8.8	-	-	-

Table 4

White Paint Samples Failing to Meet Specification Requirements

Lab. No.	Manufacturer	Code Number	Failures
82-50003	International	C-3424	Bleeding, water content % phthalic anhydride, no field tests
82-50005	Korzite	O-5566	Cold temperature viscosity, no field test
82-50007	Niagara	103590	Excessive overspray, abrasion resistance (accelerated durability)
82-50010	XYZ Paint	7WX13	Abrasion resistance
82-50011	XYZ Paint	7WX14	Viscosity, vehicle solids content, abrasion resistance
82-50014	XYZ P.C.	PC80WX13	Abrasion resistance
82-50015	XYZ P.C.	PC80WX15	Vehicle solids content, abrasion resistance
82-50022	Ibis	40-3417	Pigment content, % phthalic anhydride, reflectance, abrasion resistance
82-50023	Ibis	40-341[illegible]	Viscosity, pigment content, reflectance, abrasion resistance

Table 5

Yellow Paint Samples Failing to Meet Specification Requirements

Lab. No.	Manufacturer	Code Number	Failures
82-50026	International	C-3423	Viscosity, % phthalic anhydride, reflectance, no field test
82-50004	Korzite	C-5572	Cold temperature viscosity, bleeding, no field test
82-50009	Niagara	103591	Abrasion resistance (based on corresponding white paint sample)
82-50012	XYZ Paint	7YX13	Viscosity, vehicle solids content, abrasion resistance (per white paint sample)
82-50013	XYZ Paint	7YX14	Abrasion resistance (per white paint sample)
82-50016	XYZ P.C.	PC80YX13	Vehicle solids content, abrasion resistance (per white paint sample)
82-50017	XYZ P.C.	PC80YX14	Abrasion resistance (per white paint sample)
82-50024	Ibis	40-3418	Pigment content, vehicle solids content, % phthalic anhydride, (abrasion resistance per white paint sample)
82-50025	Ibis	40-3420	Water content, vehicle solids content, abrasion resistance (per white paint sample)

Ministry of Transportation and Communications
Ontario

APPENDIX 1

MTC FORM 1710
FEBRUARY, 1982

MATERIAL SPECIFICATION FOR CONING AND NON-CONING TRAFFIC PAINT

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1710.01 SCOPE

This specification covers the requirements for coning and non-coning traffic paints which are capable of retention of overlay type reflectorizing glass beads, and are satisfactory for application to concrete and bituminous pavements, and requirements for Ministry purchase of traffic paint.

1710.02 REFERENCES

This specification refers to the following standards, specifications or publications:

Ministry Material Specifications

Form 1750 Traffic Paint Reflectonzing Glass Beads

Canadian General Standards Board Specifications

CGSB 1-GP-12C-1955 Standard Paint Colours

CGSB 1-GP-71-1974 Method of Testing Paints and Pigments:

Method 2.1 – Density Test

Method 4.5 – Stormer Consistency Test

Method 10.1 – Test for Skinning

Method 17.1 – Volatile Matter, Paints, Enamels, and Lacquers

Method 21.1 – Pigment Content, Ordinary Centrifuge Method

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American Society for Testing Materials Specifications

ANSI/ASTM-D126 -1965 – Methods for Chemical Analysis of Yellow, Orange and Green Pigments Containing Lead Chromate and Chromium Oxide Green

ASTM-D711-1975 – No-pick-up Time of Traffic Paint

ANSI/ASTM-D713 -1969 – Method of Conducting Road Service Tests on Traffic Paint

ASTM-D868-1948 – Evaluating Degree of Bleeding of Traffic Paint

ASTM-D869-1978 – Evaluating Degree of Settling of Traffic Paint

ASTM-D969-1954 – Laboratory Test for Degree of Bleeding of Traffic Paint

ANSI/ASTM-D1210 -1979 – Test for Fineness of Dispersion of Pigmented-Vehicle Systems

ANSI/ASTM-D1306 -1980 – Test for Phthalic Anhydride Content of Alkyd and Resins and Esters Containing other Dibasic Acids

ANSI/ASTM-D1394 -1976 – Chemical Analysis of White Titanium Pigments

ANSI/ASTM-E97 -1979 – Test for 45-deg., 0-deg., Directional Reflectance of Opaque Specimens by Filter Photometry

1710.03 DEFINITIONS

Traffic Paint: means the paint used to delineate vehicle operating limits on pavement.

Non-Coning Paint: means traffic paint which when heated to 70-80°C at the spray nozzle, will be suitable for spray application and dries quickly.

Coning Paint: means traffic paint which is regular drying paint, and does not require heating prior to application.

Batch: means the paint produced from each mixing of properly proportioned paint ingredients.

1710.05 MATERIALS

1710.05.01 General

The materials used in the manufacture of the paint shall be such that the paint will not darken in service to impair the colour or visibility of the paint.

The traffic paint is intended for use with overlay beads which are applied after application of the paint. The paint shall provide proper anchorage for overlay glass beads.

NOTE: Samples of glass beads conforming to the requirements of Form 1750 and used by the Ministry for reflectorizing traffic paints may be obtained from the Ministry's Chemical Section free of charge for the purpose of determining the properties of the glass bead-paint mixture.

Paint shall be homogeneous, and shall be well ground to a uniform and smooth consistency. It shall be free from skin, dirt and other foreign particles, and shall be capable of being sprayed at the temperature intended for the type of paint (coning or non-coning) specified.

The paint shall flow evenly and smoothly and cover solidly in one coat when applied to pavements. The paint film shall be flat in finish, and shall provide a maximum amount of visibility under daylight and artificial light after the addition of the overlay glass beads.

1710.05.02 Colour and Cleaner

Paint shall conform to the following colour requirements:

(1) White paint – CGSB 1-GP-12C white 513-301

(2) Yellow paint – CGSB 1-GP-12C white 513-301 with yellow colouring to match the yellow traffic paint.
Colour chip available from the Ministry's Purchasing Office.

Cleaner solvent shall be that specified by the paint manufacturer.

1710.05.03 Physical and Chemical Requirements

Paint shall conform to the requirements of Table I.

TABLE I

TEST	REQUIREMENTS		TEST METHODS	
	Min.	Max.	C.G.S.B. 1-GP-71	A.S.T.M.
Water (% by mass)	–	0.5	24.1	–
Consistency (Krebs Units)				
at 23°C	80.0	90.0	4.5	–
at 7°C	–	120.0	4.5	–
Skinning	nil	nil	10.1	–
Settling (12 months)	8.0	–	–	D869
Hiding Power (m^2/L)*	8.37	–	–	–
Bleeding (coal tar saturated felt)	5.0	–	–	D969 and D868
Directional Reflectance (%)				
White	84.0	–	–	E97
Yellow	60.0	–	–	E97
Fineness of grind (Hegman)	3.0	–	–	D1210
Pigment Content (% by mass)	–	54.0	21.1	–
Prime Pigment (kg/L) (TiO_2 or $PbCrO_4$)	0.15	–	–	D1394 D126
Non-Volatile Vehicle (% by mass) pure alkyd resin **	18.0	–	–	
CONING PAINT				
No pick-up Time (mins.)	–	15.0	–	D711
NON-CONING PAINT				
No Tracking Time *** (mins.)	–	1.0	–	–
Phthalic Anhydride (% by mass) Content of resin	40.0	–	–	D1396

* Based on Pfund black and white Cryptometer with ≈3.5 wedge.

** Determined by subtracting the volatile and pigment content percentages from 100 percent.

*** No-tracking time:
The no-tracking time of the non-coning traffic paint shall be determined by passing over the applied beaded line in a simulated passing manoeuvre with a passenger car. A line showing no visible deposition of paint to the pavement surface when viewed from a distance of about 15 metres shall considered as showing "no-tracking" and conforming to the field drying requirement.

1710.09 MINISTRY PURCHASE OF MATERIAL BY PURCHASE ORDER

1710.09.01 Sampling and Testing

1710.09.01.01 Test Samples

Test samples of the paint which the supplier proposes to supply shall be delivered prepaid to the Ministry not later than the time and date set forth in the request for test samples, unless an extension of time has been granted by the Chemicals Section of the Ministry.

A test sample shall consist of 4 four-litre cans of each paint ordered.

Not more than two test samples from a supplier will be accepted.

All test samples shall be clearly identified by the manufacturer's name and code number. Labels on the samples shall not be glued, but shall be fastened to the cans by means of adhesive tape or other means which will allow the label to be easily removed after arrival at the laboratory.

The supplier shall submit with each test sample, one completed "Paint Data Form" (see Appendix 1). The information given by the supplier on this form will be considered confidential. Test samples for which a "Paint Data Form" has not been submitted will not be considered.

Test samples shall be delivered prepaid to the following address:

Head, Chemicals Section
Central Building, Room 105
Ministry of Transportation and Communications
1201 Wilson Avenue
Downsview, Ontario
M3M 1J8

The samples shall be tested to determine whether they meet the requirements set out in this specification and may be subjected to trial batch and storage testing as outlined below.

1710.09.01.02 Trial Batch Application

At the discretion of the Ministry, a trial production batch of paint meeting the qualifications of 1710.05.03, Table 1, may be purchased for evaluation of application properties with Ministry painting equipment. The trial batch shall consist of a minimum quantity of one 200 L drum of paint.

Paint meeting the material requirements specified in this specification and with satisfactory loading and application properties when used with Ministry traffic paint application equipment will be considered for purchase.

The above loading and application properties cover characteristics such as:

- presence of lumps of paint and/or foreign matter;
- ease of pumping during loading and spraying, i.e.: 95% of the contents of a drum shall be pumped out, using a 25.4 mm sandpiper pump (model SD-1A) with a head of 2 m, within 5 minutes. Pumping shall be at a paint temperature of 7°C and shall be pumped from a bung hole located on the top of an upright drum;
- satisfactory no tracking time;
- paint overspray on pavement and equipment, i.e.: using a 449 tip, not less than 80% of the paint leaving the spray tip shall be deposited and remain as a stripe 10 cm in width and 230 μm in dry film thickness on a target located 11.5 cm from the spray tip.

1710.09.01.03 Service Test

Paints will be service tested in accordance with ASTM D713, as amended by the following:

A service test consisting of the application of the paint on bituminous or concrete pavement with 20 000 AADT using Ministry equipment and the subsequent addition of overlay glass beads meeting the requirements of Form 1750, in the proportion of 0.7 kg of beads to one litre of paint, shall be carried out.

The ease and uniformity of application, severity of overspray (if any), covering properties and drying time will be evaluated during application.

The applied paint will be inspected periodically during the succeeding twelve months for the following:

(i) Appearance
(ii) Colour
(iii) Luminous Directional Reflectance
(iv) Abrasion Resistance (Durability)

General appearance and colour of the paint shall have satisfactory ratings (7 or higher, according to ANSI/ASTM D713) after one year of service.

The overall suitability of the paint will be based on the results obtained in the service test and compliance with all other requirements listed in this specification.

1710.09.02 Delivery and Packaging of Paint and Solvent

The delivery schedule, delivery location, colour, and quantity shall be as specified on the Ministry's Purchase Order.

The paint and solvent shall be furnished in clean new unlined non-returnable 204.5 L drums. Drums shall be 18 gauge steel having a closed head and equipped with a 50 mm bung and an 18 mm bung.

Each drum shall be clearly marked with weather resistant markings to show the following information:

a) Colour and Type of Paint (coning or non-coning)
b) Traffic Paint
c) Manufacturer's name and address
d) Manufacturer's code and batch numbers
e) Date of filling the drum
f) Volume of contents in litres

Drums shall be well made, in good condition and absolutely free from all signs of leakage, before and at the time of shipment.

A small portion of the traffic paint may be required in twenty-litre containers. The number will be specified on the Purchase Order.

1710.09.03 Quality Assurance

1710.09.03.01 General

Samples may be taken from shipments at any time; production batch samples will be taken from each batch. These samples shall be subject to inspection, and testing. The physical and chemical properties of all shipment and manufacturer's production batch samples shall be the same as those of the test sample and shall be within the limits listed in this specification. Failure to meet the requirements of this specification shall be cause for rejection of the corresponding batches of paint.

1710.09.03.02 Production Batches

Each supplier awarded a contract for the supply of traffic paint shall supply the Chemicals Section with a one-litre sample from each production batch. These production batch samples shall be delivered in the same manner as specified in Sub-section 1710.09.01.01, within two days of manufacture of the respective batches.

Delivery records shall be kept, by the supplier, of the number of containers of each batch shipped to each delivery point and a list of such shipments during each calendar week shall be given to the Ministry at the end of each week until the entire order is completed and shipped.

In addition to the physical and chemical requirements, production batch samples shall meet the following requirements:

Mass/litre – The mass/litre of each production batch sample shall be within 0.05 kg/L of the value established on the test sample.

C.G.S.B. Method 2.1 of 1-GP-71

Composition – The pigment, vehicle solids and volatile contents of each production batch sample shall be within 2% of the values established on the test sample.

C.G.S.B. Method 7.1 of 1-GP-71

No pick-up time – The laboratory no pick-up time of each production batch sample shall be within two minutes of the value established for the test samples.

1710.09.03.03 Storage

The paint shall not skin, gel, settle or cake in the drums when stored outside under summer and winter conditions for a period of one year from the time of delivery.

1710.09.04 Measurement for Payment

Traffic paint will be measured in litres.

1710.09.05 Basis of Payment

Payment at the contract price for coning or non-coning traffic paint shall be full compensation for all labour, equipment and materials including test and production samples and for supplying and delivering the paint as specified herein and by the Ministry's Purchase Order.

APPENDIX 1

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS

PAINT DATA FORM

Manufacturer _____

Manufacturer's Code No. _____

Type of Paint (coning, non-coning) _____

Colour of Paint _____

Composition of Paint	% by Mass	% by Volume
Pigment	_____	_____
Non-Volatile	_____	_____
Volatile	_____	_____

Composition of Pigment % by Mass

(1) _____

(2) _____

(3) _____

(4) _____

(5) _____

(6) _____

(7) _____

(8) _____

Type of Vehicle _____

Type of Thinner _____

Type of Driers _____

NOTE: Above form to be completed and forwarded with paint sample. Samples submitted without a completed Paint Data Form will not be considered.

Chemicals Section Comments:

MATERIAL SPECIFICATION FOR TRAFFIC PAINT REFLECTORIZING GLASS BEADS

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1750.01 SCOPE

This specification covers the requirements for glass beads for use with traffic paint and requirements for Ministry purchase of reflectorizing glass beads.

1750.02 REFERENCES

This specification refers to the following standards, specifications or publications

American Society for Testing Materials Specifications

ASTM D1155 – 1953 – Standard Test Method for Roundness of Glass Spheres

ASTM D1214 – 1958 – Standard Method of Sieve Analysis of Glass Spheres

ANSI/ASTM E11 – 1981 – Wire Cloth Sieves for Testing purposes

1750.05 MATERIALS

1750.05.01 Durability

The beads shall be manufactured from glass of a composition designed to be highly resistant to the effects of traffic wear and weathering.

1750.05.02 Colour

The glass shall be colourless to a degree that the resulting beads, when added to white paint, do not impart a noticeable hue.

1750.05.03 Bead Type and Grade

Beads shall be supplied in the OVERLAY type and MOISTURE PROOF grade. The beads shall be treated in such a manner as to overcome the effects of water, as vapour or liquid, on the beads before the beads are added to the paint stripe.

1750.07 PRODUCTION

1750.07.01 Roundness

At least 70% by mass of the glass beads shall be true spheres.

1750.07.02 Gradation

The glass beads shall meet the following gradation requirements when tested according to ASTM D1214.

US Standard ASTM E11 Sieve Series	Opening µm	Percentage Passing by Dry Mass
		Overlay Type
No. 20	850	100
No. 30	600	95 - 100
No. 40	425	45 - 70
No. 50	300	20 - 40
No. 70	212	5 - 20
No. 100	150	0 - 3

1750.07.03 **Refractive Index**

The index of refraction of the glass beads, when tested by the immersion method at 25°C under tungsten light, shall not be less than 1.50.

1750.07.04 **Imperfections**

The surface of the beads shall be smooth, lustrous and free from film, scratches and pits.

Not more than 25% by mass of the true spheres shall have imperfections such as milkiness, dark specks, incipient fractures, and air inclusions in the form of bubbles greater than 10% of the volume of the spheres.

1750.09 MINISTRY PURCHASE BY PURCHASE ORDER

1750.09.01 **Sampling and Testing**

1750.09.01.01 General

A maximum of 10% but no less than 1% of the total number of packages in each batch will be taken at random for test purposes by the Ministry. The contents of each random package will be riffled until a representative sample of approximately 1000 g (or 500 ml) of beads is obtained. The 1000 g samples will be combined to form a composite sample of about 4 kg (about 4 L in volume) representing a batch of 25 000 kg of beads. The composite sample will be riffled in the laboratory until about a 150 g sample is obtained for the following testing.

1750.09.01.02 Roundness Testing

The percentage true spheres shall be determined by one of the following methods

(a) by counting the beads under 50X and 100X magnification as follows:

- Glass beads larger than #50 sieve size inclusive, shall be counted under 50X magnification (see gradation requirements).
- Glass beads smaller than #50 sieve size shall be counted under 100X magnification.
- Approximately 1,000 beads contained loosely in a culture dish shall be counted under reflected light for each sieve specified to determine the percentage by mass of perfectly round spheres.

(b) by ASTM D1155.

1750.09.01.03 Imperfections Testing

Imperfections shall be evaluated by observation under 50X and 100X magnification.

1750.09.01.04 Water Resistance Test

One hundred grams of glass beads will be placed in a 500 ml beaker and an equivalent volume of distilled water will be flowed into the beaker on top of the glass beads. The beaker will be permitted to stand for 5 min. At the end of this period, the water shall be poured off and the glass beads will be transferred to a clean, dry beaker and permitted to stand for 5 min. The spheres will then be introduced into a stand- [illegible] 125 mm [illegible] of 125 mm [illegible] Tap [illegible] stoppage (Slight [illegible] to stem [illegible] flow through the funnel at the beginning of the test will be permissible.)

1750.09.02 **Packaging**

Beads in bags shall be free of clusters, lumps, moisture and foreign matter.

Glass beads shall be packaged in bags of 25 kg net capacity, and each bag shall be marked to show clearly the following information:

1) "Overlay Type Glass Beads"
2) "Moisture Proof Grade"
3) "MTC"
4) "Batch number"
5) "Manufacturer's name"

} (marked in 25 mm high letters)

Bags shall be paperlined burlap with 50 μm polyethylene inserts. The burlap liner, all seams and top closures shall be waterproof and leakproof and shall be capable of maintaining these properties during transportation and numerous handling.

Bags shall be approximately 0.35 m x 0.66 m with the 50 μm polyethylene insert being 0.35 m x 0.96 m.

All bags shall be subject to prior approval by the Ministry and shall be or be equal in quality to either

1) A Bemis Waterproof, Standard Type, single paper lined, cemented centre seam, taped bottom bag, produced by Bemis Bros. Bag Company, St. Louis, Missouri, U.S.A., or
2) A Lloyd jute bag with polyethylene liner, Code #210, produced by Lloyd Bag Company Limited, 114 St. Clair Street, Chatham, Ontario.

1750.09.03 Delivery

Delivery details and scheduling shall be as stipulated on the Ministry's Purchase Order.

1750.09.04 **Quality Assurance**

Any shipment or shipments of this material supplied to the Ministry will be sampled and tested within a 30 day period immediately following the date of the delivery. Failure to meet the requirements of this specification shall constitute cause for rejection of the shipment. Upon rejection of the shipment, the letters "MTC" shall be made permanently illegible on each bag of the shipment. Rejected materials shall be expeditiously removed and replaced with acceptable materials at no additional cost to the Ministry.

1750.09.05 **Measurement for Payment**

Measurement for payment will be in kilograms of beads delivered.

1750.09.06 **Basis of Payment**

Payment at the contract price per kilogram shall be full compensation for all labour, equipment and material to supply and deliver the beads as specified on the Ministry's Purchase Order.

APPENDIX 3

Non-Coning Traffic Paint Test Samples

Supplier	White Paint	Yellow Paint
International Paints (Canada) Ltd.	C 3424	C 3423
Korzite Industries Ltd.	O-5566	O-5572
Niagara Paint & Chemical Co. Ltd.	103588	103589
Niagara Paint & Chemical Co. Ltd.	103590	103591
XYZ Paint Co.	7-WX-13	7-YX-13
XYZ Paint Co.	7-WX-14	7-YX-14
XYZ Protective Coatings Ltd.	PC-80-WX-15	PC-80-YX-14
XYZ Protective Coatings Ltd.	PC-80-WX-13	PC-80-YX-13
Sherwin Williams Canada Inc.	PE 3908	PE 3909
Ibis Products Ltd.	40-3417	40-3418
Ibis Products Ltd.	40-3419	40-3420

APPENDIX 4

Test 82-01
Project 5-3

Evaluation of Non-Coning Traffic Paint - 1982

Requestor: Purchasing and Supply Office

Specifications:

(a) M.T.C. Form 1710, February 1982 Material Specification for Coning and Non-Coning Traffic Paint.

(b) M.T.C. Form 1750, February 1982 Material Specification for Traffic Paint Reflectorizing Glass Beads.

The attached memorandum from Mr. F. G. Allen requests that an evaluation of traffic paint samples (non-coning type) be carried out in 1982 for the purpose of determining suitable paints for 1983 requirements. The evaluation based on Form 1710 will be an accelerated test located on a multi-lane high volume traffic area such as the core lane of Highway 401 (see attached memo from J. Kernaghan of 82 05 31). Test samples will be received by the third week in June 1982 (see memo from M. Pellecchia 82 05 31), laboratory tested in June - July, and applied in a selected location in August 1982. The test period could last from three to four months. Reflectance readings, photographs for wear determination, and visual observations should be completed no later than November 30, 1982.

Test Procedure:

(1) Laboratory Physical and Chemical Tests

The paint samples should be tested for all applicable laboratory test requirements in Section 1710.05 except for 12 month settling and no-tracking time and those samples failing to meet any of the requirements will not be field service tested. Check for pigment settling after about 1 month (before field testing)

(2) Service Test

Those paint samples meet laboratory test requirements will be applied by the modified hot spray stripe applicator in August 1982.

The application will probably be carried out at night (Aki will determine actual working hours).

(a) Apply the paint samples at 380 µm (15 mils) wet film thickness and 10 cm in width.

(b) Apply glass beads at the rate of 0.7 kg/L. (Test stripe on panel should contain about 9.3 g of beads).

(c) If and when the "merry-go-round" test rig is constructed, the paint samples will also be evaluated by this accelerated test method.

(3) Test Site

The test site suggested by Mr. J. Kernaghan is located on 401 W/B express lanes commencing at the third light standard west of Keele Street and opposite the O/H sign truss in the collector lanes. The test area is about 440 feet long. The test stripes will probably be applied in the middle lane of the W/B express lanes.

(4) Evaluation

(a) At the Time of Paint Application

- take wet film thickness measurements
- take reflectance readings of beaded lines
- note spraying properties (overspray, spatter), colour, etc.
- note paint application temperature, pressure, etc. for each sample application
- check weight of beads on test panels for rate of bead application (use steel panels only and retain all test panels for dry film thickness measurements and for determining amount of beads used per sample)
- take photographs of the stripes from the side to include at least 3 beaded paint sample stripes. A flash unit may be required if work is done at night (note: take same photos at the end of the test period).

(b) Wear and Reflectance Readings

- the number of inspections should include the initial (at application) and final (at conclusion) measurements for reflectance and wear. Another inspection midway through the test (week of Oct. 11) may be required depending on the rate of wearing of the test stripes.

- estimate general appearance of the test stripes at the conclusion of the test period using Niteline II as a control paint. The revised specification is based on Niteline II paint characteristics so that samples with durability equal to or better than Niteline II will be considered as acceptable as determined by the accelerated service test.

(5) General Appearance

Ratings for general appearance of the test stripes in the wheel track area should be estimated and rated as follows:

10	-	perfect
9,8,7	-	good or slight failure
6,5,4	-	fair or intermediate failure
3,2,1	-	poor or bad failure
0	-	complete failure

Use rating for Niteline II test stripe as basis for rating of other test stripes.

APPENDIX 5

THE MERRY-GO-ROUND TEST SITE

Figure 1: The photograph shows the test stripes of traffic paint samples applied on bituminous pavement. The two drive wheels are running on the middle of the three concentric tracks.

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